

Appeal Brief
10/039,635

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of
Black et al.

Serial No.: 10/039,635

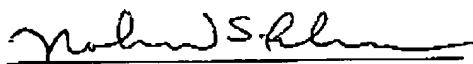
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Mohammad S. Rahman

For: SCANNING PROBE MICROSCOPY TIPS COMPOSED OF NANOPARTICLES AND
METHODS TO FORM SAME

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APPELLANTS' APPEAL BRIEF

Sirs:

The Appellants respectfully appeals the final rejection of claims 1-18, 20-29, 31-21 and
37-42, in the Office Action dated December 28, 2005. A Notice of Appeal and Pre-Appeal Brief
Request for Review was timely filed on February 28, 2006.

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I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corp., Armonk, New York, assignee of 100% interest of the above-referenced patent application.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to the Appellants, the Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-18, 20-29, 31-32, and 37-42, all the claims presently pending in the application and set forth fully in the attached claims appendix (Section VIII), are under appeal. Claims 1-29 were originally filed in the application. A non-final Office Action was issued on June 18, 2003 rejecting claims 1-29. The Appellants filed an Amendment under 37 C.F.R. §1.111 on September 17, 2003 amending claim 10 and adding claims 30-36. A non-final Office Action was issued on November 13, 2003 rejecting claims 1-36. The Appellants filed an Amendment under 37 C.F.R. §1.111 on January 29, 2004 amending claims 1, 10, and 24-28. A final Office Action was issued on March 29, 2004 rejecting claims 1-36. The Appellants filed an Amendment under 37 C.F.R. §1.116 on May 27, 2004 amending claims 1, 10, 24-28, and 30-36. An Advisory Action was issued on June 14, 2004 indicating that the Amendment filed under 37 C.F.R. §1.116 on May 27, 2004 would not be entered. On June 25, 2004 the Appellants filed a Request for Continued Examination (RCE) and an Amendment under 37 C.F.R. §1.116 to force entry of the Amendment filed concurrently on June 25, 2004 amending claims 1, 10, 24-28, and 30-36 and adding claim 37. A non-final Office Action was issued on September 8, 2004 rejecting claims 1-37. The Appellants filed an Amendment under 37 C.F.R. §1.111 on October 27, 2004 amending claims 1, 4-5, 10, 17, 24-28, 31-32, and 37. A final Office Action was issued on January 11, 2005 rejecting claims 1-37. The Appellants filed an Amendment under 37 C.F.R. §1.116 on March 1, 2005 amending claims 1, 6, 10, 24-28, and 37 and canceling claims 19, 30, and 33-36. An Advisory Action was issued on April 5, 2005 indicating that the Amendment filed under 37 C.F.R. §1.116 on March 1, 2005 would not be entered. On May 6, 2005 the Appellants filed a Request for Continued Examination (RCE) and a Statement Accompanying RCE Regarding Non-Entry

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of Previous Amendment and a Preliminary Amendment to force entry of the Preliminary Amendment filed concurrently on May 6, 2005 amending claims 1, 6, 10, 24-28, and 37 and adding claims 38-42. A non-final Office Action was issued on July 11, 2005 rejecting claims 1-18, 20-29, 31-32, and 37-42. The Appellants filed a Response under 37 C.F.R. §1.111 on October 7, 2005. A final Office Action was issued on December 28, 2005 rejecting claims 1-18, 20-29, 31-32, and 37-42. The Appellants filed a Notice of Appeal timely on February 28, 2006.

Accordingly, claims 1-13, 16-18, 20, 24-28, and 37-42 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Mirkin (U.S. Publication No. 2004/0131843) hereinafter referred to as "Mirkin 843" and Mirkin (U.S. Publication No. 2002/0063212) hereinafter referred to as "Mirkin 212", in view of Cubicciotti (U.S. Patent No. 6,762,025). Claims 14-15, 21-23, and 28-29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over "Mirkin 843", "Mirkin 212", and Cubicciotti, in view of Colbert (U.S. Publication No. 2003/0106998 A1).

IV. STATUS OF AMENDMENTS

A final Office Action was issued on December 28, 2005 stating that all the pending claims 1-18, 20-29, 31-32, and 37-42 were rejected. No after-final amendments were filed subsequent to the final Office Action of December 28, 2005. The claims shown in the claims appendix (Section VIII) are shown in their amended form as of the May 6, 2005 Preliminary Amendment.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The Appellants' claimed invention is described in pages 4 through 16 of the specification and shown in Figures 1A through 2G of the application as originally filed, whereby an object of the Appellants' claimed invention is to improve the spatial resolution of a scanning probe microscope.

With respect to claim 1, a scanning probe microscope tip (element reference numeral 1) coated with a layer of chemically-synthesized nanoparticles (element reference numeral 2 or 4) affixed to said tip (see page 7, lines 4-7 and Figure 2G of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), wherein said length differs from said width by less than approximately

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15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification), wherein said each of said nanoparticles comprises an outer coating layer (element reference numeral 3) encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings), wherein said tip is coated with an adhesion layer (element reference numeral 6) (see page 7, lines 14-20, page 8, lines 12-17 and page 9, lines 18-19 of the Appellants' specification), wherein said adhesion layer is between said tip and said nanoparticles (see page 5, lines 18-20 and Figure 2A of the Appellants' specification/drawings), and wherein said nanoparticles are generally spherical (see Figures 1A-1C and 2B-2G of the Appellants' drawings).

With respect to claims 2 and 39, wherein said scanning probe microscope tip is one of an atomic force microscope tip, a near-field scanning optical microscope tip, and a scanning tunneling microscope tip (see page 8, lines 11-12 of the Appellants' specification).

With respect to claims 3 and 40, wherein said nanoparticles comprise at least one of an amorphous, crystalline, ferromagnetic, paramagnetic, superparamagnetic, antiferromagnetic, ferrimagnetic, magneto optic, ferroelectric, piezoelectric, superconducting, semiconducting, magnetically-doped semiconducting, insulating, fluorescent, and chemically catalytic nanoparticles (see page 5, lines 15-17 and page 8, line 18 through page 9, line 2).

With respect to claim 4, wherein said outer coating layer comprises an organic layer (see page 9, lines 9-10 and lines 19-20 and Figure 2G of the Appellants' specification/drawings); wherein said nanoparticles having a diameter ranging from 2 nm to 20 nm (see page 9, lines 3-4 of the Appellants' specification), and said organic layer having a thickness ranging from 0.5 nm to 5 nm (see page 9, lines 9-10 and lines 19-20 of the Appellants' specification).

With respect to claim 5, wherein said outer coating layer comprises an organic coat comprising a head-group and a tail-group; wherein said head group comprises one of an amine, carboxylic acid, isocyanide, nitrile, phosphene, phosphonic acid, sulfonic acid, thiol, and trichlorosilane; and wherein said tail-group comprises one of an alkyl chain, aryl chain, fluorocarbon, siloxane, fluorophore, DNA, carbohydrate, and protein (see page 9, lines 9-14 of the Appellants' specification).

With respect to claim 6, wherein said adhesion layer comprises one of n-(2-aminoethyl) 3-aminopropyl-trimethoxysilane, polyethyleneimine, polymethylmethacrylate, epoxy, cyanoacrylate adhesive, and an α,ω alkyl chain (see page 7, lines 14-20 and page 8, lines 12-17

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of the Appellants' specification).

With respect to claim 7, wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle thick (see page 5, lines 7-8, page 9, lines 21-22, and Figures 2C-2F of the Appellants' specification/drawings).

With respect to claim 8, wherein said layer of chemically-synthesized nanoparticles is a single layer of nanoparticles thick and covers only the apex of said tip (see page 9, lines 2 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings).

With respect to claim 9, wherein said layer of chemically-synthesized nanoparticles comprises a single nanoparticle affixed to an apex of said tip (see page 10, lines 2-3 and Figure 2F of the Appellants' specification/drawings).

With respect to claim 10, a method of forming a scanning probe microscope tip, said method comprising coating said scanning probe microscope tip with an adhesion promoter (see page 7, lines 10-15 and Figure 2A of the Appellants' specification/drawings); dipping said scanning probe microscope tip into a liquid solution of nanoparticles (see page 8, lines 1-7, page 10, lines 14-15, and Figures 1A-1B of the Appellants' specification/drawings), each of said nanoparticles comprising a length and a width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings); and withdrawing said scanning probe microscope tip from said solution (see page 8, lines 7-8 and Figure 1C of the Appellants' specification/drawings); said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification), wherein said step of dipping causes said nanoparticles to affixed to said scanning probe microscope tip (see page 8, lines 7-8 and Figures 1B-1C of the Appellants' specification/drawings), wherein said scanning probe microscope tip comprises a tip apex (see page 9, line 19 and Figure 2A of the Appellants' specification/drawings), wherein said each of said nanoparticles comprises an outer coating layer (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings), and wherein said nanoparticles are generally spherical (see Figures 1A-1C and 2B-2G of the Appellants' drawings).

With respect to claim 11, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises dipping said scanning probe microscope tip into a monolayer of nanoparticles floating on a liquid subphase (see page 8, lines 1-7 and page 10, line 21 through page 11, line 4 of the Appellants' specification).

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With respect to claim 12, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises inking an elastomer with a plurality of nanoparticles; and dipping said scanning probe microscope tip into said elastomer (see page 5, line 21 through page 6, line 1 and page 11, lines 9-17 of the Appellants' specification).

With respect to claim 13, further comprising washing off said solution after said step of withdrawing said scanning probe microscope tip from said solution, wherein said solution is a nonvolatile solution (see page 12, lines 15-18 of the Appellants' specification).

With respect to claim 14, further comprising applying an electric potential to said scanning probe microscope tip prior to said step of dipping said scanning probe microscope tip into a solution of nanoparticles (see page 13, lines 4-9 of the Appellants' specification).

With respect to claim 15, wherein said solution further comprises an electrochemical solution, a supporting electrolyte, and an electrode held at a neutral potential (see page 13, lines 4-9 of the Appellants' specification).

With respect to claim 16, wherein said nanoparticles form a layer around said scanning probe microscope tip, wherein said layer is one nanoparticle thick (see page 9, lines 21-22 and Figures 2C-2D of the Appellants' specification/drawings).

With respect to claim 17, wherein said nanoparticles form a layer around said scanning probe microscope tip, wherein said layer comprises a single layer of nanoparticles and covers only said tip apex (see page 9, line 21 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings).

With respect to claim 18, wherein only a single nanoparticle is affixed to said tip apex (see page 10, lines 2-3 and Figure 2F of the Appellants' specification/drawings).

With respect to claim 20, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises submerging said tip into said liquid solution (see page 8, lines 1-7 of the Appellants' specification).

With respect to claim 21, wherein said nanoparticles form a layer around said tip (see page 9, line 21 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings), said method further comprising exposing said layer of nanoparticles to one of a laser light, a beam of electrons, ultraviolet light, and heat (see page 13, lines 17-19 of the Appellants' specification).

With respect to claim 22, wherein said nanoparticles form a layer around said tip (see

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page 9, line 21 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings), said method further comprising transforming said layer of nanoparticles into an electrically continuous film by annealing (see page 13, lines 19-20 of the Appellants' specification).

With respect to claim 23, wherein said nanoparticles form a layer around said tip (see page 9, line 21 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings), said method further comprising orienting uniformly the magnetic axis of said nanoparticles by annealing in the presence of a magnetic field (see page 13, line 21 through page 14, line 2 and lines 14-16 of the Appellants' specification).

With respect to claim 24, a method of forming a scanning probe microscope tip, said method comprising coating said scanning probe microscope tip, with the exception of an apex of said tip, with a sacrificial adhesion layer (see page 13, lines 10-16 of the Appellants' specification); depositing generally spherical nanoparticles over said tip (see Figures 1A-1C and 2B-2G of the Appellants' drawings), wherein said nanoparticles are affixed to said tip (see page 5, lines 13-14 and Figures 1A-1C and 2B-2G of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification); and removing said sacrificial layer (see page 13, line 15 of the Appellants' specification), wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings).

With respect to claim 25, a method of forming a scanning probe microscope tip, said method comprising coating said scanning probe microscope tip with an adhesion promoter (see page 5, line 19 and Figure 2A of the Appellants' specification/drawings); dipping said scanning probe microscope tip into a monolayer of generally spherical nanoparticles floating on a liquid subphase (see page 5, lines 19-20 and see Figures 1A-1C and 2B-2G of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification); and withdrawing said scanning probe microscope tip from said liquid subphase (see page 5, line 20 and Figure 1C of

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the Appellants' specification/drawings); wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip (see page 8, lines 7-8 and Figures 1B-1C of the Appellants' specification/drawings), wherein said scanning probe microscope tip comprises a tip apex (see page 9, line 19 and Figure 2A of the Appellants' specification/drawings), and wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings).

With respect to claim 26, a method of forming a scanning probe microscope tip, said method comprising inking an elastomer with a plurality of generally spherical nanoparticles (see page 11, lines 9-13 of the Appellants' specification), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification); coating said scanning probe microscope tip with an adhesion promoter (see page 7, lines 14-20 and Figure 2A of the Appellants' specification/drawings); dipping said scanning probe microscope tip into said elastomer (see page 11, lines 9-15 of the Appellants' specification); and withdrawing said scanning probe microscope tip from said elastomer (see page 5, line 18 through page 6, line 1 of the Appellants' specification); wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip (see page 8, lines 7-8 and Figures 1B-1C of the Appellants' specification/drawings), wherein said scanning probe microscope tip comprises a tip apex (see page 9, line 19 and Figure 2A of the Appellants' specification/drawings), and wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings).

With respect to claim 27, a method of forming a scanning probe microscope tip, said method comprising coating said scanning probe microscope tip with an adhesion promoter (see page 5, line 19 and Figure 2A of the Appellants' specification/drawings); dipping said scanning probe microscope tip into a liquid solution (see page 12, lines 1-4 and 15-17 of the Appellants' specification), wherein said liquid solution is nonvolatile and further comprises a plurality of generally spherical nanoparticles dispersed therein (see page 12, lines 1-3 and lines 15-16 and Figures 1A-1C and 2B-2G of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and

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2B-2F of the Appellants' specification/drawings), said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification); withdrawing said scanning probe microscope tip from said liquid solution (see page 12, lines 13-14 of the Appellants' specification); and washing off said liquid solution (see page 12, line 18 of the Appellants' specification), whereby said nanoparticles remain on said scanning probe microscope tip (see page 12, lines 17-18 of the Appellants' specification), wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip (see page 8, lines 7-8 and Figures 1B-1C of the Appellants' specification/drawings), wherein said scanning probe microscope tip comprises a tip apex (see page 9, line 19 and Figure 2A of the Appellants' specification/drawings), and wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings).

With respect to claim 28, a method of forming a scanning probe microscope tip, said method comprising coating said scanning probe microscope tip with an adhesion promoter (see page 5, line 19 and Figure 2A of the Appellants' specification/drawings); dipping said scanning probe microscope tip into an electrochemical solution (see page 13, lines 4-9 of the Appellants' specification), wherein said electrochemical solution comprises generally spherical nanoparticles, a solvent, and an electrode held at a neutral potential (see page 13, lines 6-7 and Figures 1A-1C and 2B-2G of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification); applying an electric potential to said scanning probe microscope tip (see page 13, lines 4-5 of the Appellants' specification); and withdrawing said scanning probe microscope tip from said electrochemical solution (see page 5, line 20 through page 6, line 3 and Figure 1C of the Appellants' specification/drawings); wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip (see page 13, lines 4-6 of the Appellants' specification), wherein said scanning probe microscope tip comprises a tip apex (see page 9, line 19 and Figure 2A of the Appellants' specification/drawings), and wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings).

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With respect to claim 29, wherein said electrochemical solution further comprises a supporting electrolyte and a reference electrode (see page 13, lines 8-9 of the Appellants' specification).

With respect to claim 31, wherein said nanoparticles comprise generally spherical cobalt nanoparticles (see Figures 1A-1C and 2B-2G of the Appellants' drawings and page 7, line 21 of the Appellants' specification).

With respect to claim 32, wherein said outer coating layer comprises a layer of oleic acid (see page 7, line 21 through page 8, line 1 of the Appellants' specification).

With respect to claim 37, a scanning probe microscope tip coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to said tip (see page 5, lines 1-2, page 7, lines 3-5, and Figures 1C and 2B-2F of the Appellants' specification/drawings), wherein said nanoparticles are shaped in a configuration other than an elongated tube configuration (see Figures 1A-1C and 2B-2G of the Appellants' drawings), wherein each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings), wherein said scanning probe microscope tip is coated with an adhesion layer (see page 7, lines 14-20, page 8, lines 12-17 and page 9, lines 18-19 of the Appellants' specification), and wherein said adhesion layer is between said tip and said nanoparticles (see page 5, lines 18-20 and Figure 2A of the Appellants' specification/drawings).

With respect to claim 38, a scanning probe microscope tip coated with a layer of chemically-synthesized nanoparticles affixed to said tip (see page 5, lines 1-2, page 7, lines 3-5, and Figures 1C and 2B-2F of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), wherein said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification), wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings), wherein said outer coating layer comprises an organic layer (see page 9, lines 9-10 and lines 19-20 and Figure 2G of the Appellants' specification/drawings), wherein said nanoparticles having a diameter ranging from 2 nm to 20 nm (see page 9, lines 3-4 of the Appellants' specification), and said organic layer having a thickness ranging from 0.5 nm to 5

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nm (see page 9, lines 9-10 and lines 19-20 of the Appellants' specification), wherein said outer coating layer comprises an organic coat comprising a head-group and a tail-group; wherein said head group comprises one of an amine, carboxylic acid, isocyanide, nitrile, phosphene, phosphonic acid, sulfonic acid, thiol, and trichlorosilane; wherein said tail-group comprises one of an alkyl chain, aryl chain, fluorocarbon, siloxane, fluorophore, DNA, carbohydrate, and protein (see page 9, lines 9-14 of the Appellants' specification), wherein said tip is coated with an adhesion layer (see page 7, lines 14-20, page 8, lines 12-17 and page 9, lines 18-19 of the Appellants' specification), wherein said adhesion layer is between said tip and said nanoparticles (see page 5, lines 18-20 and Figure 2A of the Appellants' specification/drawings), wherein said nanoparticles are generally spherical (see Figures 1A-1C and 2B-2G of the Appellants' drawings), wherein said adhesion layer comprises one of n-(2-aminoethyl) 3-aminopropyl-trimethoxysilane, polyethylineimine, polymethylmethacrylate, epoxy, cyanoacrylate adhesive, and an α,ω alkyl chain (see page 7, lines 14-20 and page 8, lines 12-17 of the Appellants' specification), wherein said layer of chemically-synthesized nanoparticles is a single layer of nanoparticles thick and covers only the apex of said tip (see page 9, lines 2 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings), and wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle thick (see page 5, lines 7-8, page 9, lines 21-22, and Figures 2C-2F of the Appellants' specification/drawings).

With respect to claim 41, wherein said layer of chemically-synthesized nanoparticles comprises a single nanoparticle affixed to an apex of said tip (see page 9, lines 2 through page 10, line 3 and Figure 2E of the Appellants' specification/drawings).

With respect to claim 42, a scanning probe microscope tip coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to said tip (see page 5, lines 1-2, page 7, lines 3-5, and Figures 1C and 2B-2F of the Appellants' specification/drawings), each of said nanoparticles comprising a length and width (see page 7, lines 11-13 and page 9, lines 3-7 and Figures 1C and 2B-2F of the Appellants' specification/drawings), wherein said length differs from said width by less than approximately 15% (see page 8, line 1 and page 9, lines 4-6 of the Appellants' specification), wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle (see page 9, lines 19-20 and Figure 2G of the Appellants' specification/drawings), wherein said tip is coated with an adhesion layer (see page 7, lines 14-20, page 8, lines 12-17 and page 9, lines 18-19 of the Appellants' specification), wherein said

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adhesion layer is between said tip and said nanoparticles (see page 5, lines 18-20 and Figure 2A of the Appellants' specification/drawings), wherein said adhesion layer comprises one of n-(2-aminoethyl) 3-aminopropyl-trimethoxysilane, polyethyleneimine, polymethylmethacrylate, epoxy, cyanoacrylate adhesive, and an α,ω alkyl chain (see page 7, lines 14-20 and page 8, lines 12-17 of the Appellants' specification), and wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle thick (see page 5, lines 7-8, page 9, lines 21-22, and Figures 2C-2F of the Appellants' specification/drawings).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The issues presented for review by the Board of Patents Appeals and Interferences are whether claims 1-13, 16-18, 20, 24-28, and 37-42 are unpatentable under 35 U.S.C. §103(a) as over "Mirkin 843" and "Mirkin 212", in view of Cubicciotti. Also, whether claims 14-15, 21-23, and 28-29 are unpatentable under 35 U.S.C. §103(a) over "Mirkin 843" and "Mirkin 212", and Cubicciotti, in view of Colbert.

VII. ARGUMENT

A. The Prior Art Rejections of Claims 1-13, 16-18, 20, 24-28, and 37-42

1. The Position in the Office Action

The Office Action rejects claims 1-13, 16-18, 20, 24-28, and 37-42 as being unpatentable under 35 U.S.C. §103(a) over "Mirkin 843" and "Mirkin 212", in view of Cubicciotti. The Office Action states that Mirkin 843 discloses the following: (a) an apparatus and method for dip pen lithography where an SPM probe tip is coated with a pattern compound that includes a nanoparticle containing additive. The coating is applied by dipping the probe tip in a solution of the patterning compound, as recited in the Appellants' claims 1, 2, 10-13, 20, 24-27, and 37-42. See paragraphs [0015], [0053], and [0093] of Mirkin 843; (b) a variety of patterning compounds that include nanoparticles, as recited in the Appellants' claims 3, 5, 6, 38, and 42. See paragraphs [0056]-[0072], [0081] and [0089] of Mirkin 843; (c) the use of 13 and 20 nm nanoparticles, as recited in the Appellants' claim 4. See paragraphs [0109] and [0114] of Mirkin 843; (d) forming a single row of 30 nm particles, as recited in the Appellants' claims 7-9, 16-18, and 38-42.

The Office Action admits that Mirkin 843 fails to teach the use of an adhesion layer, as

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recited in the Appellants' claims 1, 6, 24-28, 37, 38, and 42. However, the Office Action suggests that Mirkin 212 discloses coating the SPM tip with an adhesion layer as recited in the Appellants' claims 1, 6, 24-28, 37, 38, and 42. See paragraphs [0053] and [0054] of Mirkin 212. According to the Office Action, it would have been obvious to one of ordinary skill in the art that the nanolithography apparatus and method of Mirkin 843 can be modified to use the SPM tip coating of Mirkin 212 to provide an adhesion layer that will enhance the physisorption (adherence) of the patterning compounds to the tip. The Office Action states that it is implied that the use of nanoparticles in solution in accordance with Mirkin 843 and Mirkin 212 provides nanoparticles with an outer coating as recited in the Appellants' claims 1, 4, 5, 10, 24-28, 32, 37, 38 and 42.

The Office Action goes on to indicate that it is also implied that the formation of a single row of nanoparticles using dip pen nanolithography in accordance with Mirkin 843 and Mirkin 212 includes attaching (affixing) a single layer coating of nanoparticles to the SPM tip, which is one nanoparticle thick, as well as attaching a single nanoparticle to the tip, which, according to the Office Action, is equivalent to the limitations recited in the Appellants' claims 1, 7-18, 20, 25-28, and 38-42.

Next, the Office Action suggests that Mirkin 843 and Mirkin 212) disclose the Appellants' claimed invention except for having a specific value of length vs. width that is less than 15%, as recited in the Appellants' claims 1, 10, and 24-28. However, according to the Office Action, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select a nanoparticle having a value of length vs. width that is less than 15%.

Then, the Office Action indicates that the combination of Mirkin 843 and Mirkin 212 fails to teach the use of spherical nanoparticles, as recited in the Appellants' claims 1, 10, 24-26, 37, 38, and 42. However, the Office Action states that Cubicciotti discloses that separation of the surfaces is achieved by template-directed attachment of an effector molecule; e.g., a nanosphere to a first surface. See col. 39, lines 41-52 of Cubicciotti.

The Office Action also states that Cubicciotti teaches proximity-based methods for single-molecule detection including proximal probe methods (e.g., AFM, STM) with reporter molecules (e.g., macromolecules, polymers or preferably nanoparticles or microparticles) to select and isolate one or more aptamers based upon a user-defined selection criterion or setpoint

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(e.g., target-binding affinity).

The Office Action suggests that single-molecule affinity selection can be achieved by immobilizing a target molecule to an SPM tip (i.e., negatively charged silicon nitride) used to probe a random-sequence, nanosphere-conjugated nucleic acid library. The Office Action indicates that scanning is performed in a fluid mode to detect aptamer binding to the tip-immobilized target following the application of the nucleic acid library sample to a freshly cleaved mica substrate, as recited in the Appellants' claims 1, 10, 24-28, 37, 38, and 42. See col. 157, lines 46-67 and col. 158, lines 1-10 of Cubicciotti.

According to the Office Action, it would have been obvious to one of ordinary skill in the art that the nanolithography apparatus and method of Mirkin 843 and Mirkin 212 can be modified with the nanosphere's of Cubicciotti to provide single-molecule selection methods for identifying target-binding molecules from diverse sequence and shape libraries.

2. The Prior Art References

Mirkin 843 teaches methods of nanolithography and products therefore including a nanolithographic method referred to as high force nanografting (HFN). HFN utilizes a tip (e.g., a scanning probe microscope (SPM) tip such as an atomic force microscope (AFM) tip) to pattern a substrate passivated with a resist. In the presence of a patterning compound, the tip is used to apply a high force to the substrate to remove molecules of the resist from the substrate, whereupon molecules of the patterning compound are able to attach to the substrate to form the desired pattern.

Mirkin 212 teaches a lithographic method referred to as "dip pen" nanolithography (DPN). DPN utilizes a scanning probe microscope (SPM) tip (e.g., an atomic force microscope (AFM) tip) as a "pen," a solid-state substrate (e.g., gold) as "paper," and molecules with a chemical affinity for the solid-state substrate as "ink." Capillary transport of molecules from the SPM tip to the solid substrate is used in DPN to directly write patterns consisting of a relatively small collection of molecules in submicrometer dimensions, making DPN useful in the fabrication of a variety of microscale and nanoscale devices. Mirkin 212 also provides substrates patterned by DPN, including submicrometer combinatorial arrays, and kits, devices and software for performing DPN. Mirkin 212 further provides a method of performing AFM imaging in air. The method comprises coating an AFM tip with a hydrophobic compound, the hydrophobic

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compound being selected so that AFM imaging performed using the coated AFM tip is improved compared to AFM imaging performed using an uncoated AFM tip. Finally, Mirkin 212 provides AFM tips coated with the hydrophobic compounds.

Cubicciotti teaches single-molecule selection methods for identifying target-binding molecules from diverse sequence and shape libraries. Complexes and imprints of selected target-binding molecules are also taught in Cubicciotti. The subject selection methods are used to identify oligonucleotide and nonnucleotide molecules with desirable properties for use in pharmaceuticals, drug discovery, drug delivery, diagnostics, medical devices, cosmetics, agriculture, environmental remediation, smart materials, packaging, microelectronics and nanofabrication. Single oligonucleotide molecules with desirable binding properties are selected from diverse sequence libraries and identified by amplification and sequencing. Alternatively, selected oligonucleotide molecules are identified by sequencing without amplification. Nonnucleotide molecules with desirable properties are identified by single-molecule selection from libraries of conjugated molecules or nucleotide-encoded nonnucleotide molecules. Alternatively, target-specific nonnucleotide molecules are prepared by imprinting selected oligonucleotide molecules into nonnucleotide molecular media. Complexes and imprints of molecules identified by single-molecule selection are shown to have broad utility as drugs, prodrugs, drug delivery systems, willfully reversible cosmetics, diagnostic reagents, sensors, transducers, actuators, adhesives, adherents and novel multimolecular devices.

3. The Appellants' Position (Claims 1-13, 16-18, 20, 24-28, and 37-42)

The Appellants respectfully but strongly disagree that Mirkin 843 discloses what the Office Actions says it does. The Office Action cites paragraphs [0015], [0053], and [0093] of Mirkin as evidence for teaching the Appellants' claimed invention. However, in none of these paragraphs, or for that matter in any other paragraph, does Mirkin 843 discuss any "nanoparticle containing additives." Mirkin 843 discusses many different possible patterning compounds in paragraphs [0055] - [0074], however they are all different types of molecules, and not nanoparticles, as in the Appellants' claimed invention.

Furthermore, the Appellants strongly disagree that Mirkin 843 discloses a method for coating a probe tip with a patterning compound. Paragraph [0015] of Mirkin 843 specifically states: "The method comprising...coating the tip with a solution of the patterning compound,

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and contacting the coated tip with the substrate so that the compound is applied to the substrate so as to produce a desired pattern.” From this sentence alone it is quite clear that the patterning compound in Mirkin 843 is never even applied to the tip, rather it remains in solution when coating the tip. In fact, it is contrary to Mirkin 843’s invention to have the compound coating the tip, since the goal (as stated in paragraph [0015] of Mirkin 843) is to transfer the patterning compound to the substrate. This is directly counter to the Appellants’ claimed invention, in which nanoparticles are attached (affixed) permanently to the tip and not merely transferred to a substrate.

Furthermore, the Appellants strongly disagree that Mirkin 843 discloses patterning compounds that include nanoparticles. The Office Action cites paragraphs [0056]-[0072], [0081], and [0089] in support of this statement. As noted above, [0055] - [0074] provide a long list of possible patterning compounds, all of which are molecular compounds. However, none of these describe nanoparticles. Paragraph [0081] describes a method by which force can be applied between tip and sample – in this case, a method for applying a magnetic force. Mirkin 843 states that this can be done: “with a magnetic material located behind the tip by a current-carrying coil.” However, there is no mention of nanoparticles in relation to this method, or in fact of anything attached to a tip. Paragraph [0089] describes patterning of arrays by Mirkin’s technique. Specifically, this paragraph describes arrays of biological materials. However, there is no mention of nanoparticles in this paragraph or in any other paragraph. Furthermore, this paragraph does not describe attaching anything to a tip, let alone attaching a nanoparticle to a tip.

Mirkin 843 may describe the use of 13 and 20nm nanoparticles. However, the Appellants strongly disagree that Mirkin’s use could be augmented in the manner to stick nanoparticles on a tip. The Office Action cites paragraphs [0109] and [0114] in support of the argument.

Paragraph [0109] of Mirkin 843 describes: “a structure-forming compound comprising oligonucleotide strand B attached to 13nm nanoparticles was applied as described above.” Paragraph [0105] of Mirkin 843 describes this method: “Structure-forming compound B was applied to the substrate by immersing the substrate in a solution of the compound for an hour at room temperature so that the oligonucleotide strand B hybridized to oligonucleotide C.” It is noteworthy that this discussion involves attaching the 13nm nanoparticles (with oligonucleotide strand B attached) to the substrate, and not to a tip as in the Appellants’ claimed invention. Indeed, the essence of Mirkin 843’s invention is that structures are attached to substrates, and not

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the tips used to pattern the substrates. Paragraph [0114] of Mirkin 843 is a different example involving 20nm gold nanoparticles, however again these nanoparticles are affixed to oligonucleotide strand D and then attached to a substrate, and not a tip. Paragraph [0114] notes: "oligonucleotide strand D attached to 20nm gold nanoparticles was prepared and applied to the substrate as described in Example 1...."

To clarify, nanoparticles have not been used in SPM before because, prior to the Appellants' claimed invention, there did not exist a sufficiently good method for attaching nanoparticles to SPM tips.

Again, Mirkin 843 merely discloses a method of nanolithography utilizing a scanning probe microscope tip to pattern a substrate passivated with a resist using a patterning compound. Contrary to the assertion in the Office Action, the patterning compound is a molecular compound transferred to a substrate, not a nanoparticle affixed to a scanning probe microscope tip. Accordingly, Mirkin 843 is structurally and functionally distinct and not equivalent to the Appellants' claimed invention. (See Mirkin 843 at Abstract and paragraphs [0001] and [0006]).

The Appellants respectfully submit that the Examiner misinterprets Mirkin 843 in the Office Action. Again, although the Office Action cites paragraphs [0015], [0053], and [0093] as evidence of the Appellants' claimed invention, none of these paragraphs, or for that matter any other paragraph in Mirkin 843 appear to discuss any "nanoparticle containing additives." Instead, Mirkin 843 discusses many different possible patterning compounds, however these patterning compounds are all different types of molecules; not nanoparticles as claimed by the Appellants. (See Office Action, pages 2-4; and paragraphs [0055]-[0074] of Mirkin 843).

Accordingly, Mirkin 843 does not teach nanoparticles being affixed to a tip, let alone, an outer coating layer of a nanoparticle. Therefore, Mirkin 843 does not disclose, teach or suggest, including each of the nanoparticles includes an outer coating layer encapsulating each nanoparticle. Mirkin 212 is also deficient.

In contrast, Figures 27A and 27B of Mirkin 212 merely disclose "dip pen" lithography using a scanning probe microscope where a tip is coated with a patterning compound comprised of molecular compounds and delivered from the tip to a substrate. Although Mirkin 212 is primarily focused on using molecular compounds as a patterning compound, Mirkin 212 does suggest a single particle array formed on 300nm or 700 nm dots. However, Mirkin 212 like Mirkin 843 discloses that the patterning compound is easily removable from the tip surface with

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a suitable solvent, and thus is not affixed to the tip as in the Appellants' claimed invention. (See Mirkin 212 at Abstract; page 4, paragraphs [0049] and [0054]; page 24, paragraph [0209]; and Figures 27A and 27B).

Indeed, Mirkin 212 appears to suggest coating a tip of the scanning probe microscope, not a coating over each single particle of the array. Therefore, Mirkin 212 does not disclose, teach or suggest, including each of the nanoparticles includes an outer coating layer encapsulating each nanoparticle as claimed by the Appellants. In comparison, the Appellants' claimed invention includes a scanning probe microscope tip 1 where nanoparticles 2 are affixed to the scanning probe microscope tip 1, and each nanoparticle is encapsulated by an outer coating layer 3. The nanoparticles 2 may include cobalt nanoparticles. Further, the outer coating layer 3 may include a single molecular layer of oleic acid. (see page 7, line 20 through page 8, line 1 of the Appellants' specification).

As discussed above, Mirkin 843 only discloses molecular compounds and Mirkin 212 primarily discloses molecular compounds and suggests single particles as patterning compounds, though neither reference discloses or suggests any outer coating layer encapsulating the molecular compounds or the single particles. Accordingly, the Appellants' claimed invention provides a structure, which improves the spatial resolution of a scanning probe microscope when compared with either of the conventional Mirkin inventions.

Thus, the Appellants traverse the assertion that Mirkin 843 and Mirkin 212 teach the Appellants' claimed invention. For at least the reasons outlined above, the Appellants respectfully submit that neither Mirkin 843 nor Mirkin 212, alone or in combination with Cubicciotti, disclose, teach or suggest, including each of the nanoparticles includes an outer coating layer encapsulating each nanoparticle.

The Office Action generally argues that portions of Cubicciotti, combined with Mirkin 843 and Mirkin 212 render the Appellants' claimed invention obvious. The Appellants respectfully disagree. While Cubicciotti describes the use of nanoparticles, it does not anywhere describe affixing them to a tip, which the Appellants' claimed invention clearly provides. Cubicciotti's use of nanoparticles is to place them on a surface and allow them to selectively bind to target molecules. After binding, SPM imaging is used to see where the nanoparticles are fixed. Note here that Cubicciotti places nanoparticles on a surface, rather than on a SPM tip (see column 39, lines 41-52 of Cubicciotti).

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Cubicciotti's second described method is for fixing the target molecule to an SPM tip and then scanning it over a surface covered with a "nanosphere-conjugated nucleic acid library." (column 157, line 67). Again here, the nanospheres (or nanoparticles) are on the surface to be scanned, rather than on the SPM tip. In this case it is a target molecule (and not a nanoparticle) that is fixed to the SPM tip.

In summary, although Cubicciotti describes nanoparticles, and also discusses the use of SPM tips for single-molecule detection, he nowhere mentions the use of these nanoparticles in the manner that the Appellants' claimed invention does – that is, affixing one or more of the nanoparticles to the SPM tip.

Insofar as references may be combined to teach a particular invention, and the proposed combination of Mirkin 843, Mirkin 212, and Cubicciotti in various combinations with one another, case law establishes that, before any prior-art references may be validly combined for use in a prior-art 35 U.S.C. § 103(a) rejection, the individual references themselves or corresponding prior art must suggest that they be combined.

For example, in In re Sernaker, 217 U.S.P.Q. 1, 6 (C.A.F.C. 1983), the court stated: "[P]rior art references in combination do not make an invention obvious unless something in the prior art references would suggest the advantage to be derived from combining their teachings." Furthermore, the court in Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 U.S.P.Q.2d 1434 (C.A.F.C. 1988), stated, "[w]here prior-art references require selective combination by the court to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gleaned from the invention itself. . . . Something in the prior art must suggest the desirability and thus the obviousness of making the combination."

In the present application, the reason given to support the proposed combination is improper, and is not sufficient to selectively and gratuitously substitute parts of one reference for a part of another reference in order to try to meet, but failing nonetheless, the Appellants' novel claimed invention. Furthermore, the Appellants' claimed invention, as amended, meets the above-cited tests for obviousness by including embodiments such as having generally spherical nanoparticles affixed to the microscope tip among other features. As such, all of the claims of this application are, therefore, clearly in condition for allowance, and it is respectfully requested that the Board pass these claims to allowance and issue.

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In proceedings before the U.S. Patent and Trademark Office, the Examiner bears the burden of establishing a prima facie case of obviousness based upon the prior art. The Examiner can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. In re Fritch, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992) citing In re Fine, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988).

Here, the Examiner has not met the burden of establishing a prima facie case of obviousness. It is clear that, not only does each of Mirkin 843, Mirkin 212, and Cubicciotti, individually fail to disclose all of the elements of the claims of the Appellants' claimed invention, particularly, a scanning probe microscope tip coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to the tip, as discussed above, but also, a combination of Mirkin 843, Mirkin 212, and Cubicciotti fails to disclose these elements as well. The unique elements of the Appellants' claimed invention are clearly an advance over the prior art.

The Federal Circuit also went on to state:

The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. . . . Here the Examiner relied upon hindsight to arrive at the determination of obviousness. It is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This court has previously stated that one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. Fritch at 1784-85, citing In re Gordon, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984).

Here, there is no suggestion that Mirkin 843, Mirkin 212, and Cubicciotti alone or in combination with one another, teaches a structure and method containing all of the limitations of the Appellants' claimed invention. Consequently, there is absent the "suggestion" or "objective teaching" that would have to be made before there could be established the legally requisite "prima facie case of obviousness."

Additionally, clearly the Appellants' claimed invention is part of a crowded art field. As such, given the crowdedness of the art, the novel aspects of the Appellants' claimed invention should be regarded as a significant step forward in the constant development of this technical art field. Moreover, given that at least three separate and wholly unique references must be

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combined with one another is evidence of unobviousness.

In view of the foregoing, the Board is respectfully requested to reconsider and withdraw the rejections.

B. The Prior Art Rejections of Claims 14, 15, 21-23, 28, and 29

1. The Position in the Office Action

The Office Action rejects claims 14-15, 21-23, and 28-29 are unpatentable under 35 U.S.C. §103(a) over "Mirkin 843" and "Mirkin 212", and Cubicciotti, in view of Colbert. The Office Action admits that the combination of Mirkin 843, Mirkin 212, and Cubicciotti fails to teach the use of cured and annealed adhesion layers on a probe tip. However, according to the Office Action, Colbert teaches: (a) the use of thin adhesive layers prior to coating a probe tip with nanoparticle solutions, and the use of UV and annealing as recited in the Appellants' claims 21-23. See paragraphs [0055]-[0058] and [0168] of Colbert; and (b) dipping a probe tip into electrochemical solution and applying electrical potentials to the probe, as recited in the Appellants' claims 14, 15, 28, and 29. See paragraphs [0034] and [0060] of Colbert. Therefore, according to the Office Action, it would have been obvious to one of ordinary skill in the art that the nanolithography apparatus and method of Mirkin 843, Mirkin 212, and Cubicciotti can be modified to use the probe tip attachment methods of Colbert to provide strong, reliably mounted probe tips thereby improving conventional microscopy techniques.

2. The Prior Art References

Mirkin 843 teaches methods of nanolithography and products therefore including a nanolithographic method referred to as high force nanografting (HFN). HFN utilizes a tip (e.g., a scanning probe microscope (SPM) tip such as an atomic force microscope (AFM) tip) to pattern a substrate passivated with a resist. In the presence of a patterning compound, the tip is used to apply a high force to the substrate to remove molecules of the resist from the substrate, whereupon molecules of the patterning compound are able to attach to the substrate to form the desired pattern.

Mirkin 212 teaches a lithographic method referred to as "dip pen" nanolithography (DPN). DPN utilizes a scanning probe microscope (SPM) tip (e.g., an atomic force microscope (AFM) tip) as a "pen," a solid-state substrate (e.g., gold) as "paper," and molecules with a

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chemical affinity for the solid-state substrate as "ink." Capillary transport of molecules from the SPM tip to the solid substrate is used in DPN to directly write patterns consisting of a relatively small collection of molecules in submicrometer dimensions, making DPN useful in the fabrication of a variety of microscale and nanoscale devices. Mirkin 212 also provides substrates patterned by DPN, including submicrometer combinatorial arrays, and kits, devices and software for performing DPN. Mirkin 212 further provides a method of performing AFM imaging in air. The method comprises coating an AFM tip with a hydrophobic compound, the hydrophobic compound being selected so that AFM imaging performed using the coated AFM tip is improved compared to AFM imaging performed using an uncoated AFM tip. Finally, Mirkin 212 provides AFM tips coated with the hydrophobic compounds.

Cubicciotti teaches single-molecule selection methods for identifying target-binding molecules from diverse sequence and shape libraries. Complexes and imprints of selected target-binding molecules are also taught in Cubicciotti. The subject selection methods are used to identify oligonucleotide and nonnucleotide molecules with desirable properties for use in pharmaceuticals, drug discovery, drug delivery, diagnostics, medical devices, cosmetics, agriculture, environmental remediation, smart materials, packaging, microelectronics and nanofabrication. Single oligonucleotide molecules with desirable binding properties are selected from diverse sequence libraries and identified by amplification and sequencing. Alternatively, selected oligonucleotide molecules are identified by sequencing without amplification. Nonnucleotide molecules with desirable properties are identified by single-molecule selection from libraries of conjugated molecules or nucleotide-encoded nonnucleotide molecules. Alternatively, target-specific nonnucleotide molecules are prepared by imprinting selected oligonucleotide molecules into nonnucleotide molecular media. Complexes and imprints of molecules identified by single-molecule selection are shown to have broad utility as drugs, prodrugs, drug delivery systems, willfully reversible cosmetics, diagnostic reagents, sensors, transducers, actuators, adhesives, adherents and novel multimolecular devices.

Colbert teaches macroscopically manipulable nanoscale devices made from nanotube assemblies. The article of manufacture comprises a macroscopic mounting element capable of being manipulated or observed in a macroscale environment, and a nanoscale nanotube assembly attached to the mounting element. The article permits macroscale information to be provided to or obtained from a nanoscale environment. A method for making a macroscopically manipulable

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nanoscale devices comprises the steps of (1) providing a nanotube-containing material; (2) preparing a nanotube assembly device having at least one carbon nanotube for attachment; and (3) attaching said nanotube assembly to a surface of a mounting element.

3. The Appellants' Position (Claims 14, 15, 21-23, 28, and 29)

Indeed, the Appellants agree with the Office Action that neither Mirkin 843, Mirkin 212, or Cubicciotti disclose the use of adhesion layers and annealing, and thus these references are deficient in that they do not disclose the Appellants' claimed invention. (See Office Action, page 5, lines 9-10). Colbert is also deficient. The Appellants' claimed invention further includes an adhesion promoter (adhesion layer) to better affix the nanoparticles to the probe tip. Clearly, there is no teaching in Mirkin 843, Mirkin 212, and Cubicciotti of using an adhesion promoter to facilitate the adherence of the nanoparticles to the respective surface. Additionally, the adhesive layer described in paragraph [0055] of Colbert relates to nanotube assemblies, which as further explained below, is a separate and wholly unique application than the Appellants' claimed invention's nanoparticle assemblies.

In contrast, Colbert merely discloses macroscopically manipulable nanoscale devices made from nanotube assemblies. Colbert teaches using molecular nanotubes to fabricate devices that enable interaction between macroscopic systems and individual objects having nanometer dimension, but Colbert does not disclose or suggest the use of nanoparticles as in the Appellants' claimed invention. Nanotubes are wholly different and unique structures from the Appellants' nanoparticles. First, nanotubes, as their name suggests are generally long cylindrically-shaped structures, whereas as the Appellants' nanoparticles are generally spherical.

For emphasis, as indicated in paragraph [0034] of Colbert, "in a preferred form this device comprises a nanotube probe tip assembly made up of one or more single-wall and/or multi-wall nanotubes." Accordingly, Colbert teaches away from using the smaller nanoparticles. Indeed, the Appellants agree with the Office Action that Colbert as well as Mirkin 843 and Mirkin 212 and Cubicciotti fail to teach the use of spherical nanoparticles attached to a tip. Clearly, Colbert does not disclose or teach the use of any nanoparticles, let alone, spherical nanoparticles or a coating encapsulating nanoparticles. Therefore, Colbert does not teach or suggest including each of the nanoparticles includes an outer coating layer encapsulating each nanoparticle.

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The Appellants' claimed invention, as discussed above, includes nanoparticles 2 encapsulated with an outer coating layer 3, whereas Colbert only discloses nanotubes (element reference numeral 102 shown in Figure 1A of Colbert), not nanoparticles, let alone, nanoparticles encapsulated with an outer coating layer. Thus, the Appellants traverse the assertion that Colbert teaches the Appellants' claimed invention.

For at least the reasons outlined above, the Appellants respectfully submit that none of Mirkin 843, Mirkin 212, Cubicciotti, or Colbert, alone or in combination with one another, disclose, teach or suggest, nanoparticles including an outer coating layer encapsulating each nanoparticle.

Insofar as references may be combined to teach a particular invention, and the proposed combination of Mirkin 843, Mirkin 212, Cubicciotti, and Colbert in various combinations with one another, case law establishes that, before any prior-art references may be validly combined for use in a prior-art 35 U.S.C. § 103(a) rejection, the individual references themselves or corresponding prior art must suggest that they be combined.

For example, in In re Sernaker, 217 U.S.P.Q. 1, 6 (C.A.F.C. 1983), the court stated: “[P]rior art references in combination do not make an invention obvious unless something in the prior art references would suggest the advantage to be derived from combining their teachings.” Furthermore, the court in Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 U.S.P.Q.2d 1434 (C.A.F.C. 1988), stated, “[w]here prior-art references require selective combination by the court to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gleaned from the invention itself. . . . Something in the prior art must suggest the desirability and thus the obviousness of making the combination.”

In the present application, the reason given to support the proposed combination is improper, and is not sufficient to selectively and gratuitously substitute parts of one reference for a part of another reference in order to try to meet, but failing nonetheless, the Appellants' novel claimed invention. Furthermore, the Appellants' claimed invention, as amended, meets the above-cited tests for obviousness by including embodiments such as including an adhesion promoter prior to affixing the nanoparticles thereon. As such, all of the claims of this application are, therefore, clearly in condition for allowance, and it is respectfully requested that the Examiner pass these claims to allowance and issue.

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In proceedings before the U.S. Patent and Trademark Office, the Examiner bears the burden of establishing a *prima facie* case of obviousness based upon the prior art. The Examiner can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. In re Fritch, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992) citing In re Fine, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988).

Here, the Examiner has not met the burden of establishing a *prima facie* case of obviousness. It is clear that, not only does each of Mirkin 843, Mirkin 212, Cubicciotti, and Colbert individually fail to disclose all of the elements of the claims of the Appellants' claimed invention, particularly, a scanning probe microscope tip having an adhesion promoter thereon and coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to the tip, as discussed above, but also, a combination of Mirkin 843, Mirkin 212, Cubicciotti, and Colbert fails to disclose these elements as well. The unique elements of the Appellants' claimed invention are clearly an advance over the prior art.

The Federal Circuit also went on to state:

The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. . . . Here the Examiner relied upon hindsight to arrive at the determination of obviousness. It is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This court has previously stated that one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. Fritch at 1784-85, citing In re Gordon, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984).

Here, there is no suggestion that Mirkin 843, Mirkin 212, Cubicciotti, and Colbert alone or in combination with one another, teaches a structure and method containing all of the limitations of the Appellants' claimed invention. Consequently, there is absent the "suggestion" or "objective teaching" that would have to be made before there could be established the legally requisite "*prima facie* case of obviousness."

Additionally, clearly the Appellants' claimed invention is part of a crowded art field. As such, given the crowdedness of the art, the novel aspects of the Appellants' claimed invention should be regarded as a significant step forward in the constant development of this technical art field. Moreover, given that at least three separate references, and in some cases four separate

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references must be combined with one another is evidence of unobviousness.

In view of the foregoing, the Board is respectfully requested to reconsider and withdraw the rejections.

C. CONCLUSION

In view of the foregoing, the Appellants respectfully submit that the collective cited prior art do not teach or suggest the features defined by independent claims 1, 10, 24-28, 37, 38, and 42, and as such, claims 11, 10, 24-28, 37, 38, and 42 are patentable over Mirkin 843, Mirkin 212, Cubicciotti, and Colbert alone or in combination with one another. Further, dependent claims 2-9, 11-18, 20-23, 29, 31-32, and 39-41 are similarly patentable over Mirkin 843, Mirkin 212, Cubicciotti, and Colbert alone or in combination with one another, not only by virtue of their dependency from patentable independent claims, respectively, but also by virtue of the additional features of the Appellants' claimed invention they define. Thus, the Appellants respectfully request that the Board reconsider and withdraw the rejections of claims 1-18, 20-29, 31-32, and 37-42 and pass these claims to issue.

Please charge any deficiencies and credit any overpayments to Attorney's Deposit
Account Number 50-0510.

Respectfully submitted,



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VIII. CLAIMS APPENDIX

1. A scanning probe microscope tip coated with a layer of chemically-synthesized nanoparticles affixed to said tip, each of said nanoparticles comprising a length and width, wherein said length differs from said width by less than approximately 15%, wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle, wherein said tip is coated with an adhesion layer, wherein said adhesion layer is between said tip and said nanoparticles, and wherein said nanoparticles are generally spherical.
2. The tip of claim 1, wherein said scanning probe microscope tip is one of an atomic force microscope tip, a near-field scanning optical microscope tip, and a scanning tunneling microscope tip.
3. The tip of claim 1, wherein said nanoparticles comprise at least one of an amorphous, crystalline, ferromagnetic, paramagnetic, superparamagnetic, antiferromagnetic, ferrimagnetic, magneto optic, ferroelectric, piezoelectric, superconducting, semiconducting, magnetically-doped semiconducting, insulating, fluorescent, and chemically catalytic nanoparticles.
4. The tip of claim 1, wherein said outer coating layer comprises an organic layer; wherein said nanoparticles having a diameter ranging from 2 nm to 20 nm, and said organic layer having a thickness ranging from 0.5 nm to 5 nm.
5. The tip of claim 1, wherein said outer coating layer comprises an organic coat comprising a head-group and a tail-group; wherein said head group comprises one of an amine, carboxylic acid, isocyanide, nitrile, phosphene, phosphonic acid, sulfonic acid, thiol, and trichlorosilane; and wherein said tail-group comprises one of an alkyl chain, aryl chain, fluorocarbon, siloxane, fluorophore, DNA, carbohydrate, and protein.

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6. The tip of claim 1, wherein said adhesion layer comprises one of n-(2-aminoethyl) 3-aminopropyl-trimethoxysilane, polyethyleneimine, polymethylmethacrylate, epoxy, cyanoacrylate adhesive, and an α,ω alkyl chain.
7. The tip of claim 1, wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle thick.
8. The tip of claim 1, wherein said layer of chemically-synthesized nanoparticles is a single layer of nanoparticles thick and covers only the apex of said tip.
9. The tip of claim 1, wherein said layer of chemically-synthesized nanoparticles comprises a single nanoparticle affixed to an apex of said tip.
10. A method of forming a scanning probe microscope tip, said method comprising:
coating said scanning probe microscope tip with an adhesion promoter;
dipping said scanning probe microscope tip into a liquid solution of nanoparticles, each of said nanoparticles comprising a length and a width; and
withdrawing said scanning probe microscope tip from said solution;
said length differs from said width by less than approximately 15%,
wherein said step of dipping causes said nanoparticles to affixed to said scanning probe microscope tip,
wherein said scanning probe microscope tip comprises a tip apex,
wherein said each of said nanoparticles comprises an outer coating layer, and
wherein said nanoparticles are generally spherical.
11. The method of claim 10, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises dipping said scanning probe microscope tip into a monolayer of nanoparticles floating on a liquid subphase.
12. The method of claim 10, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises inking an elastomer with a plurality of nanoparticles;

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and dipping said scanning probe microscope tip into said elastomer.

13. The method of claim 10, further comprising washing off said solution after said step of withdrawing said scanning probe microscope tip from said solution, wherein said solution is a nonvolatile solution.

14. The method of claim 10, further comprising applying an electric potential to said scanning probe microscope tip prior to said step of dipping said scanning probe microscope tip into a solution of nanoparticles.

15. The method of claim 14, wherein said solution further comprises an electrochemical solution, a supporting electrolyte, and an electrode held at a neutral potential.

16. The method of claim 10, wherein said nanoparticles form a layer around said scanning probe microscope tip, wherein said layer is one nanoparticle thick.

17. The method of claim 10, wherein said nanoparticles form a layer around said scanning probe microscope tip, wherein said layer comprises a single layer of nanoparticles and covers only said tip apex.

18. The method of claim 10, wherein only a single nanoparticle is affixed to said tip apex.

19. (Canceled).

20. The method of claim 10, wherein said step of dipping said scanning probe microscope tip into a solution of nanoparticles comprises submerging said tip into said liquid solution.

21. The method of claim 10, wherein said nanoparticles form a layer around said tip, said method further comprising exposing said layer of nanoparticles to one of a laser light, a beam of electrons, ultraviolet light, and heat.

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22. The method of claim 10, wherein said nanoparticles form a layer around said tip, said method further comprising transforming said layer of nanoparticles into an electrically continuous film by annealing.

23. The method of claim 10, wherein said nanoparticles form a layer around said tip, said method further comprising orienting uniformly the magnetic axis of said nanoparticles by annealing in the presence of a magnetic field.

24. A method of forming a scanning probe microscope tip, said method comprising:
coating said scanning probe microscope tip, with the exception of an apex of said tip,
with a sacrificial adhesion layer;

depositing generally spherical nanoparticles over said tip, wherein said nanoparticles are
affixed to said tip, each of said nanoparticles comprising a length and width, said length differs
from said width by less than approximately 15%; and

removing said sacrificial layer,
wherein said each of said nanoparticles comprises an outer coating layer encapsulating
each nanoparticle.

25. A method of forming a scanning probe microscope tip, said method comprising:
coating said scanning probe microscope tip with an adhesion promoter;
dipping said scanning probe microscope tip into a monolayer of generally spherical
nanoparticles floating on a liquid subphase, each of said nanoparticles comprising a length and
width, said length differs from said width by less than approximately 15%; and

removing said scanning probe microscope tip from said liquid subphase;
wherein said step of dipping causes said nanoparticles to affix to said scanning probe
microscope tip,

wherein said scanning probe microscope tip comprises a tip apex, and
wherein said each of said nanoparticles comprises an outer coating layer encapsulating
each nanoparticle.

26. A method of forming a scanning probe microscope tip, said method comprising:

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inking an elastomer with a plurality of generally spherical nanoparticles, each of said nanoparticles comprising a length and width, said length differs from said width by less than approximately 15%;

coating said scanning probe microscope tip with an adhesion promoter;

dipping said scanning probe microscope tip into said elastomer; and

withdrawing said scanning probe microscope tip from said elastomer;

wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip,

wherein said scanning probe microscope tip comprises a tip apex, and

wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle.

27. A method of forming a scanning probe microscope tip, said method comprising:

coating said scanning probe microscope tip with an adhesion promoter;

dipping said scanning probe microscope tip into a liquid solution, wherein said liquid solution is nonvolatile and further comprises a plurality of generally spherical nanoparticles dispersed therein, each of said nanoparticles comprising a length and width, said length differs from said width by less than approximately 15%;

withdrawing said scanning probe microscope tip from said liquid solution; and

washing off said liquid solution, whereby said nanoparticles remain on said scanning probe microscope tip,

wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip,

wherein said scanning probe microscope tip comprises a tip apex, and

wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle.

28. A method of forming a scanning probe microscope tip, said method comprising:

coating said scanning probe microscope tip with an adhesion promoter;

dipping said scanning probe microscope tip into an electrochemical solution, wherein said electrochemical solution comprises generally spherical nanoparticles, a solvent, and an

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electrode held at a neutral potential, each of said nanoparticles comprising a length and width, said length differs from said width by less than approximately 15%;

applying an electric potential to said scanning probe microscope tip; and

withdrawing said scanning probe microscope tip from said electrochemical solution;

wherein said step of dipping causes said nanoparticles to affix to said scanning probe microscope tip,

wherein said scanning probe microscope tip comprises a tip apex, and

wherein said each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle.

29. The method of claim 28, wherein said electrochemical solution further comprises a supporting electrolyte and a reference electrode.

30. (Canceled).

31. The tip of claim 1, wherein said nanoparticles comprise generally spherical cobalt nanoparticles.

32. The tip of claim 1, wherein said outer coating layer comprises a layer of oleic acid.

33-36. (Canceled).

37. A scanning probe microscope tip coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to said tip, wherein said nanoparticles are shaped in a configuration other than an elongated tube configuration, wherein each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle, wherein said scanning probe microscope tip is coated with an adhesion layer, and wherein said adhesion layer is between said tip and said nanoparticles.

38. A scanning probe microscope tip coated with a layer of chemically-synthesized nanoparticles affixed to said tip, each of said nanoparticles comprising a length and width,

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wherein said length differs from said width by less than approximately 15%,
wherein said each of said nanoparticles comprises an outer coating layer encapsulating
each nanoparticle,
wherein said outer coating layer comprises an organic layer,
wherein said nanoparticles having a diameter ranging from 2 nm to 20 nm, and said
organic layer having a thickness ranging from 0.5 nm to 5 nm,
wherein said outer coating layer comprises an organic coat comprising a head-group and
a tail-group;
wherein said head group comprises one of an amine, carboxylic acid, isocyanide, nitrile,
phosphene, phosphonic acid, sulfonic acid, thiol, and trichlorosilane;
wherein said tail-group comprises one of an alkyl chain, aryl chain, fluorocarbon,
siloxane, fluorophore, DNA, carbohydrate, and protein,
wherein said tip is coated with an adhesion layer,
wherein said adhesion layer is between said tip and said nanoparticles,
wherein said nanoparticles are generally spherical,
wherein said adhesion layer comprises one of n-(2-aminoethyl)
3-aminopropyl-trimethoxysilane, polyethylineimine, polymethylmethacrylate, epoxy,
cyanoacrylate adhesive, and an α,ω alkyl chain,
wherein said layer of chemically-synthesized nanoparticles is a single layer of
nanoparticles thick and covers only the apex of said tip, and
wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle
thick.

39. The tip of claim 38, wherein said scanning probe microscope tip is one of an atomic force microscope tip, a near-field scanning optical microscope tip, and a scanning tunneling microscope tip.

40. The tip of claim 38, wherein said nanoparticles comprise at least one of an amorphous, crystalline, ferromagnetic, paramagnetic, superparamagnetic, antiferromagnetic, ferrimagnetic, magneto optic, ferroelectric, piezoelectric, superconducting, semiconducting, magnetically-doped semiconducting, insulating, fluorescent, and chemically catalytic

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nanoparticles.

41. The tip of claim 38, wherein said layer of chemically-synthesized nanoparticles comprises a single nanoparticle affixed to an apex of said tip.

42. A scanning probe microscope tip coated with a layer of chemically-synthesized generally spherical nanoparticles affixed to said tip, each of said nanoparticles comprising a length and width, wherein said length differs from said width by less than approximately 15%,

wherein each of said nanoparticles comprises an outer coating layer encapsulating each nanoparticle,

wherein said tip is coated with an adhesion layer,

wherein said adhesion layer is between said tip and said nanoparticles,

wherein said adhesion layer comprises one of n-(2-aminoethyl) 3-aminopropyl-trimethoxysilane, polyethyleneimine, polymethylmethacrylate, epoxy, cyanoacrylate adhesive, and an α,ω alkyl chain, and

wherein said layer of chemically-synthesized nanoparticles is at least one nanoparticle thick.

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IX. EVIDENCE APPENDIX

There is no other evidence known to the Appellants, the Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

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X. RELATED PROCEEDINGS APPENDIX

There are no other related proceedings known to the Appellants, the Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.